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(1) Offenlegungsschrift

(19) Japanese Patent Office (JP)

(12) **Laid-Open Utility Models Gazette** (U)

(11) Laid-Open Utility Model Application Number
Ut. Kokai H 5-32872
(43) Laid-Open Date: 30 April 1993

(51) Int. Cl.[6]	Identification code	Internal office filing numbers	FI	Technical display section
F 16 J 15/08	P	7233-3J		

Examination request Requested, Number of claims 2, (Total 2 pp.{in the original})

(21) Application no. Ut. Appn. H 3-81690

(22) Application date 8 October 1991

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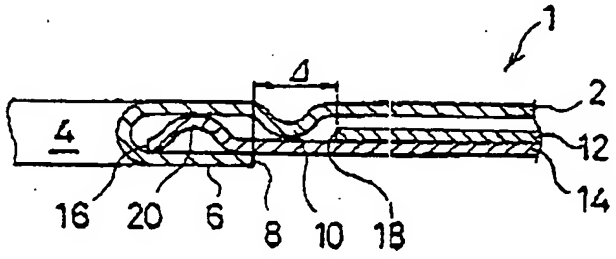
(54) [**Title of the device**] Metal gasket having an expansion part

(57) [**Abstract**]

[**Aim**] The aim is to provide a metal gasket which prevents cracks from occurring in the area around a folded-over part due to factors such as thermal-expansion differences between: the bead in contact with the joining surfaces; the gasket which has a structure whereby it is folded-over to the side on which the bead projects, at the circumferential edge of the hole intended to be sealed; and the joining surfaces.

[**Constitution**] A thin metal sheet 2 is folded over at the circumferential edge of a sealing hole 4 and a folded-over part 6 is formed around the sealing hole; a gap Δ is provided between the outer circumferential edge 8 of the said folded-over part 6 and the opening 18 of a thickness-adjusting sheet 12, and an expansion part 10 is formed in the thin metal sheet 2 in the said gap Δ portion.



[**Scope of utility model registration claim**]

[**Claim 1**] Metal gasket wherein one surface sheet comprising a laminated thin metal sheet is folded over at the circumferential edge of a sealing hole and a folded-over part is formed around the sealing hole; a thickness-adjusting sheet comprising a thin metal sheet is laminated onto the abovementioned surface sheet; the said thickness-adjusting sheet is provided with an opening encircling the hole intended to be sealed; the said opening provides a ring-shaped gap between itself and the outer circumferential edge of the abovementioned folded-over part; and the abovementioned surface sheet in the said gap portion has an expansion part formed with an expansion part comprising a channel encircling the hole intended to be sealed.

[**Claim 2**] Metal gasket having an expansion part as claimed in Claim 1, wherein the abovementioned expansion part is formed with a meandering channel shape.

[**Brief explanation of the drawings**]

[**Figure 1**] This is a cross-section of the main parts of a metal gasket of Embodiment 1 of the present design.

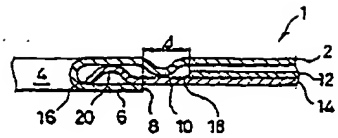
[**Figure 2**] This is a partial overhead plan view of the main parts of Figure 1.

[**Figure 3**] This is a cross-section of the main parts of a metal gasket of Embodiment 2 of the design.

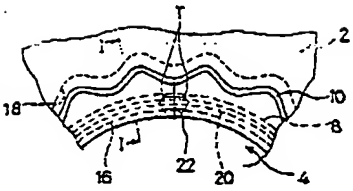
[**Explanation of the references**]

1	Metal gasket	2	Thin metal sheet
4	Sealing hole	6	Folded-over part
8	Outer circumferential edge	10	Expansion part
12	Thickness-adjusting sheet	14	Thin metal sheet
20	Bead	T	Tearing force

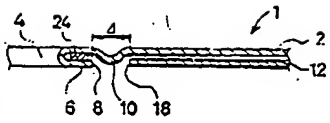
(Fig. 1)



(Fig. 2)



(Fig. 3)



[**Detailed description of the device**]

[0001]

[**Field of use in industry**]

The present design relates to a metal gasket having an expansion part comprising a thin metal sheet.

[0002]

[**Prior art**]

By way of an example of the prior art, metal gaskets such as the head gaskets of internal combustion engines have been constituted in such a way that a bead has been formed in, or a wire ring has been provided on, a gasket-constituting sheet comprising a resilient thin metal sheet in such a way as to produce a surface pressure for sealing the area around a sealing hole such as a combustion-chamber hole, and additionally a surface sheet has been folded over at the circumferential edge of the sealing hole towards the opposite side in such a way as to cover the abovementioned bead or wire ring and in such a way that fluid does not penetrate the inside of the gasket. It is common knowledge that, when compressed, the abovementioned bead or wire ring is resiliently deformed and makes hermetic contact against the joining surfaces due to the resulting reaction force, and thereby performs the role of a seal.

[0003]

[**Problems to be overcome by the device**]

However, in applications such as, for example, high-performance aluminium-alloy internal combustion engines where the combustion pressure is high, the head bolts exert substantial tightening forces and the temperature difference during use and non-use is substantial, the cylinder head experiences substantial thermal expansion and contraction, which itself is substantially different from the expansion and contraction of the gasket which is made of a different material. When the construction is such that the

abovementioned bead or wire ring is covered by the abovementioned folded-over sheet, the said portion is pressed against the joining surfaces under considerable force and thus the surface sheet does not readily slide over the joining surface, and a tearing force occurs in the said portion. If the gasket is used for a long time under such conditions and the mechanical strength of the thin metal sheet deteriorates due to thermal fatigue, metal fatigue or the like and its resistance to the abovementioned tearing force reduces, then there is a problem in that cracks occur in the area around the folded-over part.

[0004]

The present device has taken this problem into account and aims to provide a metal gasket having a configuration whereby, at the circumferential edge of a hole intended to be sealed, it is folded over to the opposite side so as to cover a sealing means such as a bead; wherein the metal gasket has an expansion part which prevents the occurrence of cracks in the area around the abovementioned folded-over part due to factors such as the thermal-expansion difference between the said gasket and the members which are to be sealed.

[0005]

[Means of overcoming the problems]

The metal gasket having an expansion part of the present design for achieving the above aim is one wherein one surface sheet comprising a laminated thin metal sheet is folded over at the circumferential edge of a sealing hole and a folded-over part is formed around the sealing hole; a thickness-adjusting sheet comprising a thin metal sheet is laminated onto the abovementioned surface sheet; the said thickness-adjusting sheet is provided with an opening encircling the hole intended to be sealed; the said opening provides a ring-shaped gap between itself and the outer

circumferential edge of the abovementioned folded-over part; and the abovementioned surface sheet in the said gap portion is formed with an expansion part comprising a channel encircling the hole intended to be sealed.

[0006]

There are no particular restrictions on the cross-sectional shape of the abovementioned expansion part, and shapes which have conventionally been used for beads can be appropriately employed, for example trapezoidal, involving the provision of one or a plurality of elements formed into an arc-shaped or mountain-ridge-shaped or other such waveform. Further, the said expansion part can also be formed with a meandering shape.

Because the total sheet thickness of the abovementioned expansion part is thin in the said portion, it has a lower compressive strength than other portions and is able to expand and contract in response to the tension acting around the sealing hole. Consequently, any tearing forces occurring in the area around the folded-over part can be absorbed, thereby preventing cracks from occurring. Additionally, if the expansion part is made to meander, as mentioned above, then, relative to the tension acting in the longitudinal direction of the bead, the said meandering portion will inevitably have nearby a portion which intersects with the direction in which the said tension acts. Thus, cracks can be prevented from occurring irrespective of the direction in which the tension acts.

[0007]

A laminated gasket will usually be used as the metal gasket of the present design, but a single-sheet gasket can also be employed. Further, a sealant may also be coated on to the gasket surface(s) in order to hermetically seal what are known as tool marks, minute scratches in the joining surfaces.

[0008]

[Embodiments]

The present design is described in more specific detail below by means of embodiments, and with reference to the accompanying drawings.

In the metal gasket 1 of Embodiment 1 shown in Figure 1 and Figure 2, a folded-over part 6 is formed by folding over a surface sheet 2 (which comprises a thin metal sheet) at the circumferential edge of a hole 4 to be sealed (referred to as the "sealing hole" hereinbelow), for example the cylinder hole of an internal combustion engine (not depicted) or the like, and an expansion part 10 is formed around the sealing hole 4 outward from the outer circumferential edge 8 of the said folded-over part 6. As shown in Figure 1, the said expansion part 10 is formed with an arc-shaped cross-section in the width direction and its protruding side is made to project towards the folded-over part 6 (which is to say into the metal gasket 1), and, as shown in Figure 2, it is formed with a meandering shape in the circumferential direction. It should be noted that Figure 2 exaggerates the abovementioned meandering. Also, a thickness-adjusting sheet 12 comprising a thin metal sheet for thickness adjustment, and another surface sheet 14 are laminated on the side towards which the said expansion part 10 projects.

[0009]

The surface sheet 14 is provided with an opening 16 around the sealing hole 4 in such a way that the surface sheet 14 overlaps with the folded-over part 6, and is formed with a bead 20 adjacent to the circumferential edge of the opening 16, the arrangement being such as to overlap with the folded-over part 6. Further, the thickness-adjusting sheet 12 employs a sheet which is slightly thinner than the surface sheet 2 such that compression forces are concentrated in the bead 20, is

provided with an opening 18 around the sealing hole 4 in such a way that it does not interfere with the expansion part 10, and is arranged in such a way that there is a gap Δ between the opening 16 and the opening 18. The shape of the said opening 18 as seen in overhead plan view is made to meander as shown in Figure 2, and is formed in such a way as to ensure uniform spacing from the expansion part 10.

[0010]

A description now follows, with reference to Figure 2, of the action when the abovementioned metal gasket 1 is fitted between joining surfaces (not depicted) whose coefficient (or coefficients) of thermal expansion is (are) different from that of the said gasket. By way of illustration, in internal combustion engines used in large vehicles the length of thermal expansion in the longitudinal direction when the engine is running and when the engine has stopped can be as much as 100 microns. Consequently, there is a substantial length of joining-surface slippage due to the difference from the thermal-expansion coefficient of the gasket when the gasket uses a highly resilient metal such as spring steel. Now, because the total sheet thickness in the portion where the expansion part 10 is provided is thin, the compression forces which act there are small and thus it can expand and contract. Thus, when a tearing force comes to act along the folded-over part 6 because of the abovementioned substantial length of slippage, the expansion part 10 can expand and absorb the tearing force and prevent cracks from occurring.

10 wird aber dort Sepresst Wenn auch Geringer

[0011]

An explanation is now given of the situation which applies when the metal gasket 1 is in the compressed state and a portion 22 (Figure 2) of the expansion part 10 experiences tension T, indicated by the transparent arrows, for a reason such as the abovementioned

substantial difference in thermal-expansion coefficients. The surface sheet 2 on the side where the thickness-adjusting sheet 12 is located (which is to say the side where the total sheet thickness is slightly thinner) is able to deform, and thus the abovementioned tension T concentrates in the vicinity of the folded-over part 6. However, in its width direction, the expansion part 10 of Embodiment 1 inevitably has a portion in the direction in which the abovementioned tension T acts, and the said portion can resiliently deform and extend and can absorb the tearing force. Consequently, cracks can be prevented from occurring in the surface sheet 2 in the double-dot and chain portion in situations where the abovementioned tension T exceeds the strength of the surface sheet 2 for a reason such as reduction in strength of the abovementioned spring steel due to long-term use.

[0012]

In the metal gasket 1 of Embodiment 2 shown in Figure 3, a gap Δ is formed between the opening 8 and the opening 18 in such a way that the expansion part 10 touches the contacting surfaces (not depicted) on both sides, and a thin thickness-adjusting sheet 24 in the shape of a ring around the sealing hole 4 is interposed in the folded-over part 6, the arrangement being such that compression forces concentrate in the said portion. In this case the thickness-adjusting sheet 12 which forms one of the surface sheets has been rendered integral with the surface sheet 2 from which the folded-over part 6 and the expansion part 10 have been formed, using a means such as caulking which is not depicted. Thus high fastening forces do not act on the said expansion part 10 even if the expansion part 10 makes contact with the joining surfaces on both sides. Consequently, similarly to Embodiment 1, whatever the direction of any tearing forces, the said tearing forces

can be absorbed due to the presence of the expansion part 10 provided in the width direction, close to the point of the said action. It will be appreciated that the abovementioned expansion part 10 of the present device can be provided parallel to the sealing hole 4 rather than meandering as described above. Further, when the position where the tension T of Figure 2 acts is clear, meandering need only be introduced in the vicinity of the said portion alone.

[0013]

[Advantages of the device]

As described above, the present device is a metal gasket in which a folded-over part is formed around a sealing hole and which is provided with a folded-over part which covers a sealing means such as a bead; wherein the expansion part is provided in the vicinity of the sealing means and thus cracks can be prevented from occurring even when the strength has deteriorated to below the abovementioned tearing force due to thermal degradation or the like. Consequently, the reliability of metal gaskets can be improved and they can be used stably over a long time.

Translator's Notes

Japanese Laid-Open Utility Model H 5-32872

The following points were noted during the course of the above translation
(Line numbers refer to the Japanese text)

Throughout the text

The term translated as "Hole intended to be sealed" has been derived from Japanese which more usually would simply translate as "Sealing hole" (and a term which most literally reads "Seal hole" has been rendered as "Sealing hole").

Section	Line	Comment
Claim 1	8	The English reflects the Japanese in the expression "an expansion part formed with an expansion part".
0003	6	The English reflects the Japanese in the introduction of a somewhat unexpected "the said" in the phrase "the said portion is pressed against the joining surfaces".
0006	2	The English reflects the Japanese in the somewhat disjointed way in which the phrase beginning "involving the provision" connects with the rest of the sentence. It is noted that this phrasing is changed in the subsequent, related document (Ut. Mod. Kokoku H8-5419).
0006	5	The English reflects the Japanese in the use of "the said". It is noted that this phrasing is changed to "this" in the subsequent, related document.
0009	5	The English again reflects the Japanese in the phrase "a gap Δ between the opening 16 and the opening 18". It is noted that this phrase is greatly lengthened in the related document, with the effect that "the opening 16" changes to "the outer circumferential edge 8".
0011	2	It may be of note that Japanese reading "blanked out" has been translated as "transparent" since Figure 2 shows a two-way arrow which has a transparent body rather than a white one.
0011	5	The precise intended meaning of the phrase "in its width direction" is not clear. It is noted that this passage has been reworked in the related document.
0012	5	The Japanese term "*Kashime*" is "caulking" in the context of boats and cars. Although this seems the most likely rendering, "Kashime" can also mean 'self-locking' as in 'self-locking nut'.

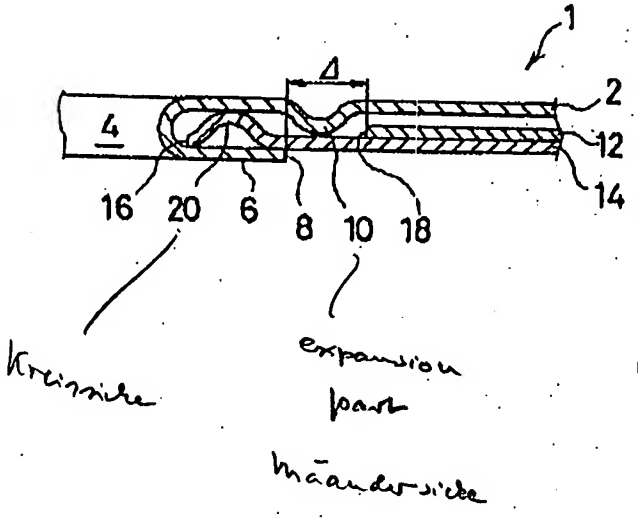
リング状の隙間を設け、該隙間部分の前記表面板に、シールする穴を囲繞する溝条から成る伸縮部を形成した伸縮部を有する金属ガスケット。

【請求項２】　前記伸縮部を蛇行させた溝状によって形成した請求項１記載の伸縮部を有する金属ガスケット。

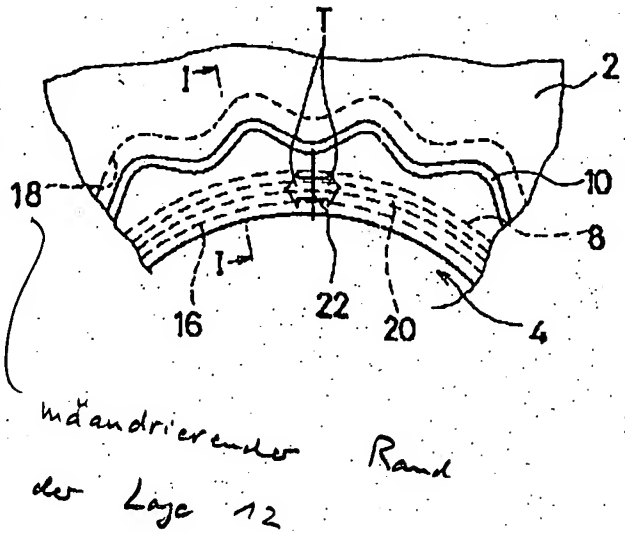
【図面の簡単な説明】

1　金属ガスケット
2　金属薄板
4　シール穴
6　折返し部
8　外周縁
10　伸縮部
12　厚み調整板
14　金属薄板
20　ビード
T　引裂き力

【図１】



【図２】



【図３】